STUDENTSTUDYPROJECT

ON

"Synergyofwaterandreservoirmanagement:AComprehensive study " ofDr.BurgulaRamakrishnaRao Govt. degree, JadcherlaTownofMahabubnagardistrict, TelanganaIndia"

DepartmentofZoology

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CERTIFICATE

This is certify that the projectworkentitiled"Synergy of water and Reservoir Management : A Comprehensive study of "Dr. BURGULA RAMA KRISHNA RAO GOVT DEGREE COLLEGE, Jadcherla" is a bonafied work done by P.Adithyavarma , M. Raghavender, S. Santhosh , M. Venkatesh , P. Raju (BZCs) , the students of BSC. (BZC) E/M, VI semester students under my supervision in Zoology at the Department of Zoology " DR. BRR GOVT COLLEGE JADCHERLA" during 2022- 23 and the work as not be submiotted in any another college or university either part or full for the award of my degree.

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Date :

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Signature of external examiner

Signature of Internal examiner

Signature of Principal

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DECLARATION

We P. Adithya Varma , S. Santhosh , M. Raghavender, M . Venkatesh, P. Raju here by declare that these project report entitled:Synergy of Water and Reservoir Maintainance: A Comprehensive Study. Jadcherla ,Mahabubnagar (Dist), Telangana State is a genuine

Record of project work done by us by the guidance of "Smt K. Neeraja" Assistant professor Department of Zoology of DR. BURUGULA RAMA KRISHNA RAO Jadcherla and as not be submitted to any universities or institution of the award of any degree or diploma

Further declare that the advancement of knowledge in science .

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Contents

ABSTRACT

This abstract presents a simplified overview of the project on Reservoir Water aintainanace and Treatment, focusing on the goal ensuring a safe and sustainable water ply . The project aims to assess the condition of the reservoir , identify potential source of contamination , implement maintainance measures and treat the water to remove ontaminates. By emphasizing the importancy of safe water for public health , the project promot's responsible water usage and highlights the need for collaborative efforts to maintain and treat reservoir water effectively.

1.INTRODUCTION

Bacteriological water testing is a method of collecting water samples and analysing thosesamples toestimatethenumbersofbacteriapresent.

Naturalwatersuppliessuchasriverslakes,andstreamscontainssufficient nutrientstosupportthe growth of various organisms. Microorganisms enter the water supply in several differentways. In congested centres water supplies get polluted by domestic and industrial waste. As apotential carrier of pathogenic microorganisms, water can endanger health and life. From thestandpointoftransmitting humandisease,pollutingwaterwithsoil,rubbish, industrialwastes,and even animal manure is comparatively harmless. These sources rarely contain pathogenscapableofproducinghumandiseaseswhenswallowedwithdrinkingwatersewagecontainingh umanexcreta,however,ismostdangerousmaterialsthatpolluteswater.Peoplewithcommunicablediseasesofmanykindseliminate thecausative organismsintheirexcreta.

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Otherorganisms,naturallypresentintheenvironment andnot regardedaspathogens,mayalsocause opportunist disease. Ideally, drinking water should not contain any microorganismsknown to be pathogenic. It should be free from bacteria indicative of pollution with excreta.Themajorityofthepopulationindevelopingcountriesisnot adequatelysuppliedwithpotablewater,andthusobligedtouse unsafe waterfor domesticanddrinking purposes.

Hence,itisessentialto checkthequalityoftheavailabledrinkingwaterfromvarioussources.

Inviewofthispresentstudywasdesignedtoanalysethemicrobiologicalqualityofthe availabledrinkingwaterfromvarioussourceslike foodstalls,teastalls,supplywater,packagedwatert ofacilitatetheexamination oflevel ofcontaminationandfinallyhencetheriskassociatedwiththeirconsumption.

Since, most of earlier undertaken studies in India have dealt with physical and chemicalparameters of drinking water quality. Hence the study has been designed to examine themicrobiologicalqualityofavailabledrinkingwater.

SourceofDomesticWaterJ

uralaProject

TheJuralaProjectisamultipurposeirrigationprojectlocatedontheRiverKrishnain Telangana,India.ThewaterfromJuralaProjectisprimarilyusedforirrigation,drinkingwatersupply, andindustrialpurposes.

To bring water from Jurala Project to Jadcherla for the Mission Bhagiratha Project, a series ofcanals and pipelines have been constructed. The water is first released from the Jurala Damand flows through the Jurala Canal, which is a gravity canal that carries water to variousvillages andtowns alongthe way.

From there, the water is diverted into a network of pipelines that carry it to Jadcherla. Thesepipelines are laid underground to prevent evaporation and ensure that the water reaches itsdestinationefficiently.

The water is then stored in reservoirs and tanks in Jadcherla, where it undergoes treatmentbeforeitissuppliedtohouseholdsandindustriesthroughadistributionnetwork.

Overall, the Jurala Project plays a crucial role in providing water for the Mission BhagirathaProject,whichaimsto provide safedrinkingwatertoeveryhouseholdinTelangana.

WaterTreatmentPlants

DetailsofwatertreatmentplantNagasala,Jadcherla.TheNagasala water treatment plant in Jadcherla, Telangana is a majorsource of drinking water for the surrounding communities. Here aresomedetails abouttheplant:

Capacity: Theplanthasacapacityof77millionlitrespe

Location: ThewatertreatmentplantislocatedinNagasalavillage,nearJadcherlaintheMahbubnagardistrictofTelangana,India.

Sourceofwater: TheplanttreatswaterfromtheKagnaRiver, whichisatributaryoftheKrishnaRiver.

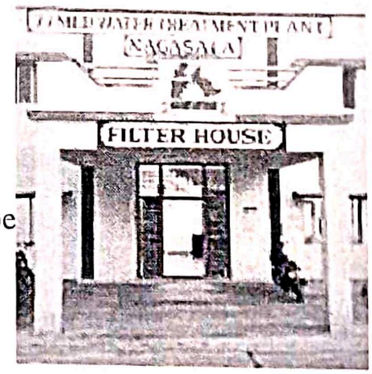


Figure 1 Water treatment plant, Nagasala

Treatmentprocess: Theplantusesaconventionaltreatmentprocessthatincludescoagulation,flocculation,sedimentation,andfiltrationtoremoveimpuritiesfromthewater.Chlorineisalsoadded todisinfectthewaterbeforeitisdistributedtoconsumers.

Ownership: TheNagasalawatertreatment plantisownedandoperatedbytheTelanganaStateDrinkingWaterSupplyCorporation(TSDWSC).

Figure3:NagasalaWatertreatmentplant

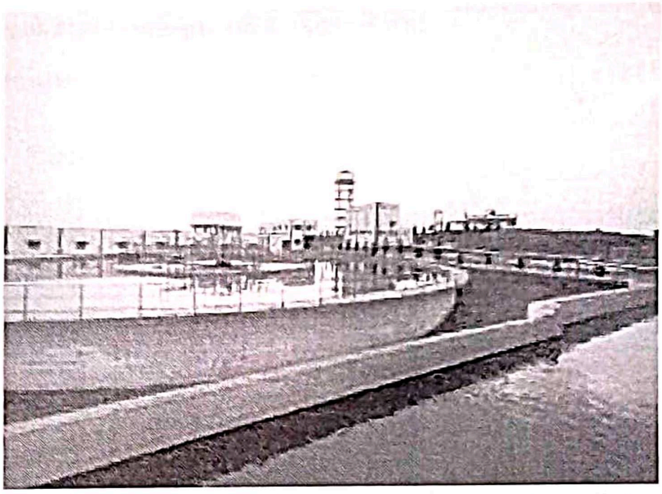


Figure2:Externalviewofwatertreatmentplant

StepsforPurificationonLargeScale

Step 1:Collection

TherawwaterwhichissuppliedtothewatertreatmentplantcomesfromJuralaProjectbuiltonKrishnaRiver

Step2:WaterAeration

Water aerationistheprocessofincreasingormaintainingtheoxygensaturationofwaterinboth natural and artificial environments. Aeration techniques are commonly used in pond,lake,and reservoirmanagementtoaddresslowoxygenlevelsor algalblooms.

Figure4:WaterAerator

Step3:Coagulation

- Raw water is treated with chemical coagulant Alum (Aluminium Sulphate) was in therange of 5-40 mg/L of water. The dose of Alum where is depending upon turbidity,colour,temperatureandPHofthewater.
  - HerewesawtherawwatercomingfromKrishnaRiver whichwasthenmixedwithAlumandChlorine

Step4:FlashMixing

- Treatedwaterissubjectedtoviolentagitationinamixingchamberforfewminutes
- Theseallowsquickandrapid disseminationofAlumthroughoutthebulk ofthe water.

Step5:Flocculation

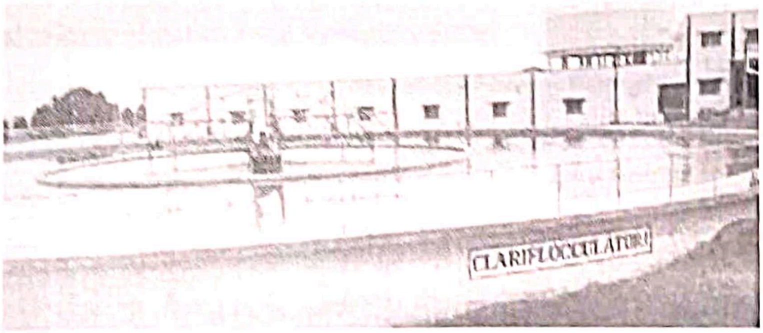


Figure5:Clariflocculator-flocculationchamber

- Thisphaseinvolvesa slowandgentlestirringofthetreatedwaterinaflocculationchamber.
- Themechanizedtypeofrotor ismostcommonlyused. Itconsistsofanumber ofpaddles whichrotates at2-4rpm.
- Thisslowandgentlestirringcausestheformationofaluminiumhydroxide.
- Thethickertheprecipitateis,thehigheristhesettlingvelocity.
- Thesuperficiallayerofwaterisnowremovedalongwiththeflocculentmaterial.

Step6:Sedimentation

- The coagulated water is now lead into sedimentation tank where it is detained for 2-6hrs when the flocculent precipitate together with impurities and bacteria settle downinthetank.

- At least 955 of the flocculation precipitate needs to be removed from the water beforeitis admittedtotherapidfilters.
- Thesludgeorprecipitateidremovedfromthebottomofthetankwithoutdisturbingtheoperationofthetank.

Step7:Filtration

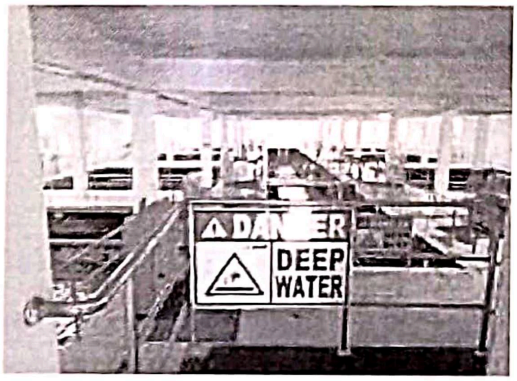


Figure6 WaterFiltrationBeds

- Eachfilterunithas4sandbeds–filtersand,coarsesand,finegravel. Thethicknessofsandbedis1m
  - The effective size of sand particle is 0.4 – 0.7mm
  - Belowthesandbed, alayerofgradedgravelof30–40m
- Thedepthofthewaterontthetopofthesandbedis5-6feet
- Theunderdrainsatthebottomatthebottomofthe filter bedcollectsthefilterwater.Therateoffiltration is5-25cum/sqm/hr.
- Thealumflocformsaslimylayer whichabsorbsbacteriafromthewater andeffectspurification of water. This alum floc is not removed by sedimentation and held backonthesamebed'.
- Oxidationofammonia alsotakesplaceduringthepassageofwaterthroughfilters.

Step 8:Backwashing

- Asfilterproceeds,thesuspendedimpuritiesandbacteriaclogthefilters.
- Thefilter sonbecomesdirtyandbegintolosetheirefficiency
- Itdislodgestheimpuritiesandcleansupthesandbed.
- Washingisstoppedwhenclearsandisvisibleandthewashwaterissufficientlyclean
- Ittakesabout 15mins

Step9:Disinfection

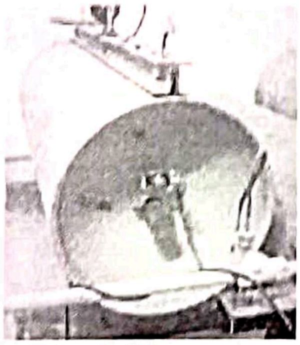


Figure 7 Chlorine gas storage cylinder

- Thisisthelaststepbeforethestorageanddistributionofthis water.
- TheprocessusedinChlorination.
- Thechlorinegasisusedforeffectivedisinfection

PrinciplesofChlorination:

1 Watershould be freefromturbidity.

2 Chorinedemandshouldbeestimated

3 Contact period

4 Minimumrecommendedconcentrationoffreechorineis mg/lfor1hour

5 The Chlorine demand of water is the difference between the amount of chlorineremainingattheendoftreatment(after1hr).Theresidualchlorineconcentrationis0.5mg/Lfor1hr

Action ofchlorine

– When Chlorine is added to the water the is a formation of hydrochloric acid andhypochlorousacid.Thedisinfectingactionofchlorineisduetohypochlorousacid.

Step 10:Reservoir

- Wehavevisitedthereservoir wherethepurifiedwaterwasstored
- Fromthereitwassuppliedtoapproximately483nearbyvillages.

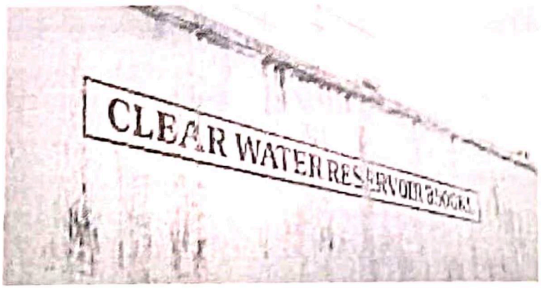


Figure8 Clearwaterreservoir

Figure 9 Clear water pumphouse

GROUNDWATERPROBLEMINJADCHERLA

ABSTRACT

The ground water problem is explained by drinking water, domestic water, industrial water.Water problems are experienced in Jadcherla due to management and space problem. Jurala project Krishna river water and srisailam water are source of water in jadcherla. It is a policy thatneeds to extract ground water is to inform district commissioner ten days in advance. DistrictCommissioner has no powers to refuse or scrutinize applications.. Extraction of ground water in notified areas was anoffenceunderpreviouspolicy.Themainaimandobjectivesofthisworkistocomeacrossthe issue of ground water quality in Jadcherla. To examine the affordability of water to getconnected inrelationtospace,the customers'abilitytopayforwatersupplies,accessibilityof the lines to customers to get connected, availability of water even after connection, and theseasonal effect on water availability. Human life is highly unhygienic as well as suffersserious health problem due to water quality. Ground water in Jadcherla has relation withspace, economy, policy and managementThese spaces are not officially allowed forwatersupplyconnectionandboreholes. Peoplearesustaininglifewithpoorqualityofgroundwater.

1. OBJECTIVESOFSTUDY

1. Delineationofground waterpotentialzonewiththehelp ofRS andGIStechnique.

2. Tofindoutthesuitablezone ofground waterqualityfor urbandevelopmentandplanning.

2. 2.Parametersselectedforcollected watersamples

Thefollowingbasicparametersincludedinthisstudy:

2. 2.1.Physicalparameters

Thephysicalparameterstestedincludetemperate,conductivity,color,odourandturbidity.Thetempe rature and the conductivity are tested using suitable instrument Multiparameter Testr 35Series of Eutech make. The colour and odour are determined by visual observations of thecollectedwater samples.

2. 2.2.Chemicalparameters

The chemical parameters included in this study are based on the determination of the pH,Salinity,TotalDissolvedSolids(TDS)andthedetectionofharmfulchemicalsironandfluoride.Th e pH, Salinity and TDS are measured using Multi-parameter Tester 35 Series of Eutechmake after calibrating the instrument with suitable standard buffers before testing individualparameters following manufacturer's instructions. The iron and fluoride are estimated usingAQUA Check Iron Test Kit and Fluoride Test Kit of HI Media Laboratories respectivelyaccordingtotheinstructions suppliedwiththekits.

2. 2.3.Bacteriologicalparameters

For thedetection of presenceor absenceof coliformbacteriain collectedsamplewatercommerciallyavailablePAColiformKit MS1186ofHiMediaLaboratoriesisusedinthisstudy.The procedures followed according to instructions provided along with the kit. Briefly theentirequantityofdehydrated mediumPABrothforasingletest isdissolvedbyswirlingin100mlofsample.

Afterdissolutionthemixtureisincubated in35°Cfor48hrs.Thecolourchangeofthemediumafterincubationsignifiesthepresenceorabsenceo fcoliforms.Therapiddetectionofpathogenic bacterial strains simultaneously in water samples including Salmonella species, E.coli,CitrobacterspeciesandVibriospeciestheHIWaterTestKitK015of HIMediaLaboratories is suitably used following the instructions supplied with the kit. Supplied withinthe kit two dehydrated media; 'Medium A' for the simultaneous detection of Salmonella, E.coli, Citrobacter species in sample water and 'Medium B' for the detection of Vibrio species(V.choleraV.parahaemolyticus,otherVibrio's)

3. RESULTS

ThesamplewatercollectedfromvariouspartsofKolkataareanalysedbasedonthephysical,chemicala ndmicrobiologicalparameters.

3. 1.Analysesofthephysicalparameters

3. 1. 1.Colour

Colour in surface water and ground waters results primarily from the presence of naturalorganic matter, particularly aquatic humic matter (APHA et al., 2012). In this study almost allthesamplewatercollectedfrommunicipaltapandhouseholdsourcesarecolorlessexceptthosecoll ected from tube wells or ponds (Table 1). The appearance of slight turbidity on visualinspection in the ground water samples gave a deviation from the true colorless state of theother samples. The turbidity in water samples is caused due to suspended and colloid matterssuchasclay,silts,finelydividedorganicand inorganicmatter,planktonandothermicroscopicorganisms (McCoyandOlson,1986;APHAetal.,2012).

Odourisrecognizedasaqualityfactoraffectingacceptabilityofdrinkingwaterforhumanuse(U.S. EPA, 1973). Since some odourous materials are detectable when present in only a fewnanograms per litre it is usually impractical and sometimes impossible to isolate and identifythe odour-producing chemicals. The human nose is the practical odour-testing device used inthismethod(MallevialleandSuffet,1987).Allthesamplesanalysedwereodourlesswhicharecollected from tap or household containers. The sample from the tube wells and ponds gaveunobjectionableodour

3.1.3.Temperature

The temperature of the water samples varied according to time of collection. The watercollected from household sources showed minor variations in temperature while the watercollected from open water-bodies varies with location although the range of variation is notveryhigh

3. 1.4.Conductivity

The electrical conductivity is a measure of the ability of an aqueous solution to carry anelectrical current. This ability depends on the presence of ions; on their total concentration,mobility and valence. In SI (International System of Units) conductivity is reported as millisiemens per meter (mS/m) or µS/cm where 1 mS/m = 10 µS/cm (APHA et al., 2012). Theconductivity of the potable water samples varied in different areas of Kolkata and it rangedwithin 210 µS/cm – 945 µS/cm (Table 1). According to European Economic CommunityStandards for physiochemical parameters in relation to the natural water structure, guide levelforconductivityis400µS/cm(AWWA,1990)

3. 2. Analyses of the chemical parameters3.2.1.pH

The pH value of tested water samples refers to the intensity of the acidic or alkaline conditionof a solution (Murhekar, 2011). Changes in pH values can directly affect metabolic activity ofliving organisms. The pH values of water also determine the chemistry and availability ofnutrients.OrganismshavealimitedrangeofpHtolerance.Naturallevelsofthealkalinityreferstothe conditionwhenpH value exceeds7tend nottobeasimportantaslevelsofaciditysinceit pose a constraint on the organismal function and activities (Cain et al., 2014). The pHinterfereswiththechemicalreactionsofwaterandhenceconsideredvaluedfactorforrepresenting water quality (Fakayode, 2005). For sustenance of aquatic biota, pH must bewithintherangeof6.5to8.2(Wang,2002).ThepHvalueobtainedwhenthedifferentsamplewaters from various areas and sources in Kolkata are analysed ranged from 7.85-8.68 (Table2)showingalkalinenature.

3. 2.2.Salinity

Salinity is conceived as a measure of the mass of dissolved salts in a given mass of aquaticsolution. Freshwater has very little salt, usually less than 0.5 ppt (parts per thousand). Waterwithsalinityof0.5-17pptisknownasbrackishwater.Seawateronanaverageshowsasalinityof 30-40 ppt (APHA et al., 2012). The sample water investigated in this study is mainly freshwater and ground water. The salinity levels in the collected water samples in Kolkata rangedfrom0.121-0.511ppt

3. 2. 3. TotalDissolvedSolids(TDS)

TDS values are the result of the higher ionic deposition (Singh, 2010). Lower values of theTDS denoted the less ionic concentration, which may the result of ample rainfall and surface(Bhatt etal.,1999).WaterswithhighTDSgenerallyareofinferiorpalatabilityandmayinducean unfavorable physiological reaction in transient consumers. The desirable limit for TDS indrinking water is 500 mg/l (APHA et al., 2012). The TDS determined inthis study in selectedlocationsandsources ofpotablewatervariedwithina rangefrom154mg/lto666mg/l

3.2. 4.Iron

Iron usually occurs in all natural waters in both oxidised (Ferric) as well as reduced (Ferrous)forms. Since the ground water is often anoxic any soluble iron is mostly present in the ferrousstate.AccordingtoU.S.EPAthestandardconcentrationsofironindrinkingwaterarenormally lessthan0.3mg/l(APHAetal.,2012)butitvariesandcanhaveahigherconcentrationwherecast iron, steel or galvanised iron pipes are used for water distribution(WHO, 2006). Presenceof iron in water promotes growth of undesirable iron bacteria that result in deposition of slimycoating in the piping (WHO, 2006; AWWA, 1990; Rannamaee and Veldre, 1998). Elevatediron levels in water can impart objectionable taste and colours (APHA, et al., 2012). Theestimated iron concentration in this study in certain locations of Kolkata ranged from 0.1mg/lto0.5mg/l(Table2).

3.2.5.Fluoride

Fluoride is widely distributed in the lithosphere and hydrosphere. Because of the dissolvingpower of water and movement of water in hydrological cycle fluoride is found in all waters(AWWA,1990).AccordingtoWyattetal.,(Wyattetal.,1997)thereisalinkbetweenarsenic(As) and fluoride (F) in drinking water. Two forms of chronic effects are recognised generallyas being caused by excess intake of fluoride over long periods of time. These are mottling oftoothenamelordentalfluorosisandskeletalfluorosis(Srikanthetal.,2002;Maldeetal.,1997;Mascarenhas,2000;Shivshankaraetal.,2000).Theconcentrationoffluoridesonwaterfollowsacomplexeffectonhumanhealth.Aconcentrationoffluoride lessthan0.5 mg/lisresponsiblefordentalcariesabove0.9mg/lisresponsiblefortheappearanceofthediseasefluorosis.Thusthe WHO guidelinevalueforfluoride concentrationis 0.5-0.9mg/l (WHO,2006). Theconcentrationoffluoride levelsdetectedinwatersamplesindifferentzonesofKolkatarangedfrom0.1mg/l-0.4mg/l

3. 3. Analysisofthebacteriologicalparameters

The contamination of drinking water sources with microbial pathogens is the leading cause ofmorethanthree milliondeathseveryyearfromwater-relateddiseaseand43%ofwater-relateddeaths are due to diarrhoea (WHO, 2008). The majority of the infectious diseases are causedby bacteria, fungi, viruses and parasites associated with human excreta which contaminatewatersupplies(TambekarandHirulkar,2007).Thecoliformbacteriawereregardedasa groupbelongingtothegeneraEscherechia,Citrobacter,KlebsiellaandEnterobacter,butothergenera includingSerratiaandHafnia.
Thetotalcoliformgroupincludesbothfaecalandenvironmentalspeciesandtheyoccurinbothsewage and natural waters. Some of the bacteria belonging to the total coliformare excreted inhuman faecesbutmanycoliformsareheterotrophicandmultiply inwaterand soil.
The indicator organism of choice for faecal pollution is E. coli. Thermotolerant coliforms

enzyme β-galactosidase. Methods including MPN (Most Probable Number) and P/A tests(Presence/Absence)are generally employedforthe coliform detection in drinking water(Ashbolt et al., 2001; Grabow, 1996; Sueiro et al., 2001; WHO, 2006). The PA Coliform Kitis used in this study to detect harmful coliform bacteria in potable water samples in certainlocations ofKolkata.

Presenceof coliformbacteriadetectedinsamplescollectedfrom Dumdum,Goabagan,Sakuntalapark, Kestopore and Anandapur (Table 3). The probability of major pathogenicbacterialspecieswhichareincludedinthepresenceofcoliforminthesampletestedincludes E. aerogenes, E. coli, E. faecalis, K. pneumonia, S. typhimurium (Greenberg et al., 1985). ForrapidandsimultaneousdetectionofSalmonellaspecies,E.coli,CitrobacterspeciesandVibriospecies the HiWater Test Kit is used. The Medium A supplied with HiWater Test kit utilizesthe modified form of Manja et al. (Manja et al., 1982) protocol where the differentiation ofbacterial species belonging to Salmonella, Citrobacter was based on H2S production and thedetectionofE.colionthebasis ofcolourchangeofthemedium.

The chemical composition of the medium A includes Peptone as source of Nitrogen, FerricAmmonium Citrate and Sodium thiosulphate. The production of H2S gas is identified whenthe sample water containing enteric bacterial species belonging to group of Salmonella orCitrobacter reduces Sodium thiosulphate. The other reagents presentin the medium likeDipotassium hydrogen phosphate acts as a buffer and Sodium lauryl sulphate inhibits thegrowth of associated microflora. Bromocresol purple acts as an indicator for pH change as theoriginalreddish-purplecolourofthemediumshiftstoyellowsignifyingthepresenceofE.colibacterialspecies.Thediffer entsamplewatertestedinthisstudyshowedthepresenceofE.coli,Salmonella species and Citrobacterspeciesin certain locations of Kolkata Similarly theMediumBsuppliedinthesamekitistheVibriobrothfortheidentification oftheV.cholera, V. parahaemolyticus and other Vibrio species. Briefly the medium contains Peptone, Sodiumcitrate, Bile salt, Sucrose, Sodium thiosulphate, Sodium chloride and Indicator mix. Sucroseactsasfermentablecarbohydrateandthiosulphateisthesulphursource.ThealkalinepHhelpsintheisolationoftheV.cholera.IncubatingtheMediumB mixingwithdifferentsamplewaterin this study in Kolkata detected V. cholerae as well as V. parahaemolyticus in certain watersamples collected

4. DISCUSSION

The present study was planned to monitor the potable water quality consumed or used by thepeople residing in congested and overcrowded areas of the city Kolkata. The water samplechosenforanalysesincludedthedrinkingwateraswellasthewaterusedfordaytodayhumanactivities like cooking, mouth washing, bathing etc. The sample water collected from household containers are used for drinking and those from tube wells and municipal taps as well asopen water bodies like ponds are used for drinking in some locations as well as doing otheractivities. The storage of drinking water is also an important aspect for quality of waterassessment. The stored drinking water from house hold sources located in thickly populatedslumareaareverypronetoacquirecoliformandotherindicatormicroorganismduringstorageor the conditions of the containers used for storing. Moreover the pollutanload of drinkingwaterissignificantlyinfluencedbythepipesandfittings(Seifert

Moreover, in congested city like Kolkata drinking water and sewage pipelines usually run atcloseproximitycreatingahugeprobabilityofmixingofwatersduetoleakageofoldpipelines.

According to WHO guideline (WHO, 2006) presence of organic colouring matter in waterstimulatesthegrowthofmanymicroorganisms.Discolourationofpotablewatermayarisefromthedissolutionofironorcopperindistributionpipes,whichcanbeenhancedbybacteriologicalprocesses. Microbiological action can also produce 'red water' resulting from the oxidation ofiron from ferrous to ferric by iron bacteria (WHO, 2006). In this study the colour of the watersamples collected from tube-well in areas such as Beliaghata, Thakurpukur and Anandapurshowed a slight reddish tinge whereas those collected from ponds in areas like Sakuntalapark,Kestopore and Dumdum were turbid. Similarly the sample water collected from ponds andtube-wells from areas like Dumdum, Sakuntalapark, Beliaghata, KestoporeThakurpukur andAnandapur when tested an unobjectionable odour was detected in those samples in contrast tosamplecollectedfromeithertaporhouseholdbottlesindifferentlocalities.Thiswascorrelatedwith the fact that those samples were not colourless in contrast to other samples. Thus thepresence of odour in those samples signified the presence of microbial, chemical and physicalcontaminants of water.The conductivity of water guide value is 400 µS/cm (AWWA, 1990).The sample tested in this study showed that water collected from ponds and tube-wells have aconductivity range much higher than the acceptable value. The water collected from tap orhouseholdbottleswere withinthe permissiblelimitsexceptthe tap watercollectedfromBurrabazararea.
The pH parameter of the tested water sample in Kolkata was in the alkaline range which issuitable for human consumption. Similarly the salinity of the water samples is in the normalrangeof 0.5pptexceptinDumdum pondsamplewherethevalueexceedsthenormallimit.Total Dissolved Solids (TDS) comprise inorganic salts including Ca, Mg, K, Na, HCO_3,Cl andSO_4aswellassmall amountsof organicmatter thataredissolvedinaqueousmedium.Water gets contaminated with TDS from natural sources, sewage, urban runoff andindustrialwastewater.AccordingtoWHOguidelinestheconcentrationofTDSinpotablewatergreater than 1200 mg/l is objectionable whereas extremely low concentration renders flat,insipid taste to drinking water (WHO, 2006). The sample water tested in Kolkata the TDSconcentrationiswithintheacceptablelimit of500mg/l(APHA,et al.,2012)inmajorityofthesample tested except the sample from Dumdum pond and Anandapur tube-well where beyondacceptablelimitconcentrationhavebeendetectedinthis study.

Iron is the most abundant element, by weight, in the earth's crust. Iron is the secondmostabundant metal in earth's crust. It is an essential element in human nutrition. The minimumdailyrequirementofironrangedfromabout10to50 mg/day(WHO1988).Ironconcentrationgreater than 1.0 mg/l markedly impair the potability of the water and there is usually nonoticeable taste at iron concentration below 0.3 mg/l (WHO 2003). Natural water containsvariable amounts of iron and in ground water it is normally present in the ferrous or bivalentfrom(Fe^{++})(Kumarand Puri2012).TheironconcentrationestimatedinthesamplecollectedfromdifferentareasofKolkataaremoreorlesswithinrangeof0.3mg/lexceptionsnoticedinareasincludingDumdum,Sakuntalapark, Beliaghata,KestoporeandAnandapurwhererelativelyhigherconcentrationswerenoticed.

The maximum permissible limit of fluoride in drinking water is 1.5 ppm or mg/l and highestdesirablelimit higherconcentrationskeletalfluorosis.Incontrastlowconcentration(approximately0.5ppm)provides protection against dental caries. According to previous report India is among the 23nations around the globe where fluoride related health problems occur due to the consumptionofdrinkingwaterhavinghighconcentrationoffluoride from1.0to400mg/l.Moreoveritwasalso reported that near about 20 million people are affected by fluorosis and about 40 millionpeople are exposed to risk of endemic fluorosis (Chinoy, 1991; Kumar and Puri 2012). In thepresent study conducted in Kolkata in the state of West Bengal, India, the concentration offluorideinthe watersample testedis withinthepermissiblelimit.

Fecalcoliformbacteriaareacollectionofrelativelyharmlessmicroorganismsthatliveinlargenumber in the intestines of the warm and cold blooded animals. They aid in the digestion offood. Specific subgroups of this collection are the fecal coliform bacteria, the most commonmember being Escherichia coli (E. coli). The presence of indicator organisms (E. coli orthermotolerant coliform bacteria) in water indicates recent contamination of the water sourcewith fecal matter and hence possible presence of intestinal pathogens. According to WorldHealth Organization (WHO) guidelines (WHO, 1996), E. coli or thermotolerant coliformbacteria should not be detectable in any water intended for drinkingAt the time this occurred,the source water may have been contaminated by pathogens or disease-producing bacteria orviruses which can also exist in fecal material. Some water-borne pathogenic diseases includetyphoidfever,viral,andbacterialgastroenteritisandhepatitisA.

The presence of fecal contamination is an indicator that a potential health risk exists forindividuals exposed to this water (WHO, 1996). The presence or absence of faecal indicatorbacteriaisanothercommonlyusedoperationalmonitoringparameter.Therearecontaminatingpathogens that are resistant to disinfectants (Chlorination) than the commonly used indicatororganism E. coli or thermotolerant coliforms including the presence of more resistant faecalindicatorbacteria(Intestinalenterococci),Clostridiumperfringessporesorcoliphages(WHO,2012).ThusthepresenceorabsenceofE.colicannotbeasuitable indexforthedeterminationof other bacteria in water sample. In the present study the presence/absence of coliforms aredeterminedinsamplewatercollectedincertainareas ofKolkatadistrict.

The presence of coliforms were detected in samples collected from Dumdum, Goabagan,Sakuntalapark, Kestopore and Anandapur suggesting proper time to time monitoring as wellas purification of the water sources are of urgent need. The presence of coliforms in watercollected from ponds (Dumdum, Kestopore, Sakuntalapark) signified the contamination offaecalmattersinthosewaterbodies.ThesampleobtainedfromGoabaganwhichwascollectedfrom house hold bottles signified either there is contamination in the supply tank from wherethewateriskeptandalsothecontainerwhereitisstored.

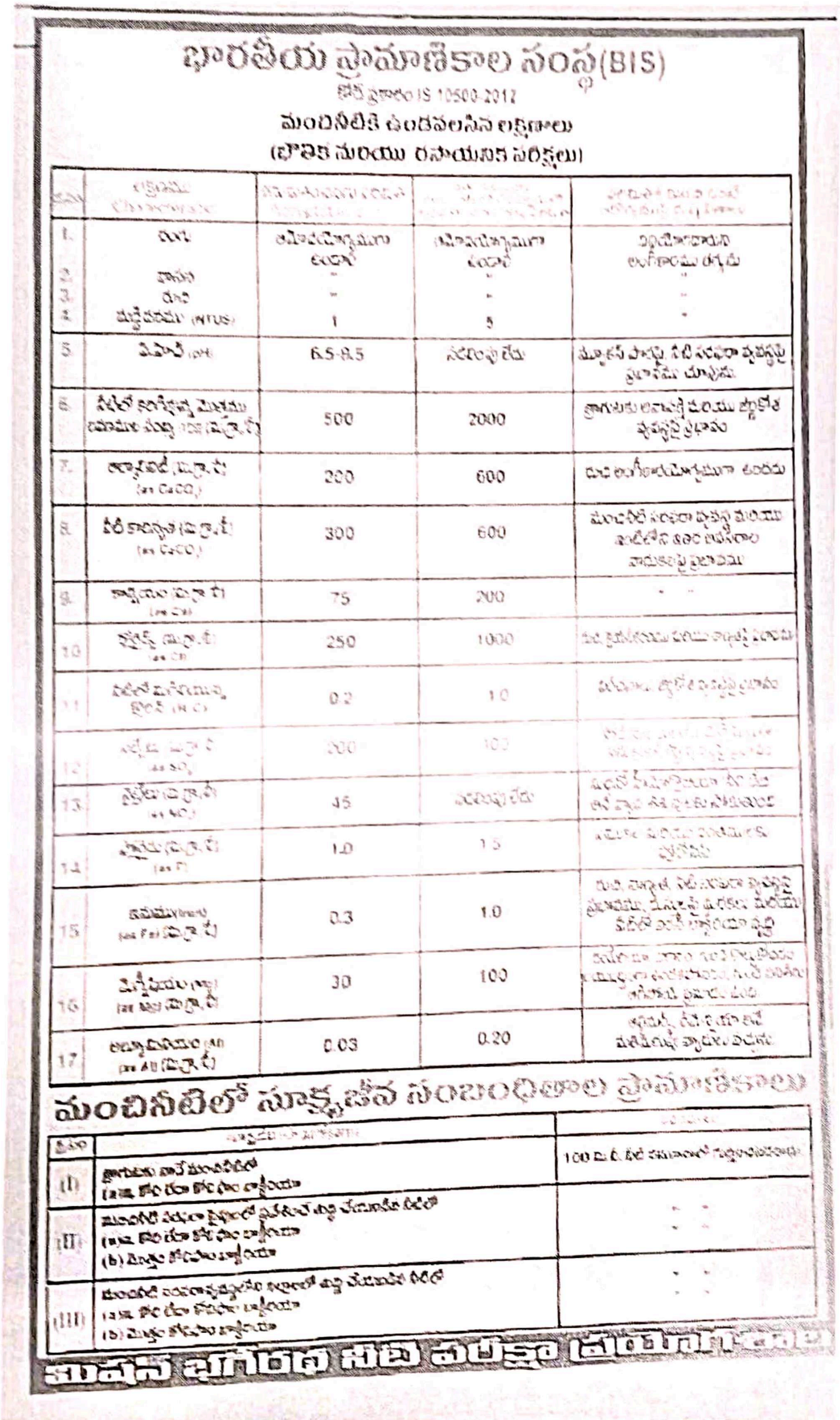
The sample collected from Anandapur tube-well might be contaminated from undergroundsource. Analyses of the water samplesfor the presence/absence bacterianamely E.coli,Salmonella,CitrobacterandVibriospeciesgavepositiveresultsincertainsamplesinvestigated.

E. coli was detected in majority of the samples irrespective of whether collected from openwaterbodiesorundergroundsourceorhouseholdsourceormunicipaltap.IncontrastSalmonella, Citrobacter species as well as Vibrio species occurrances were detected in few ofthesamples(Table3).Thissignifiedthatthesamplewatercollectedfromselectedovercrowdedpart

5. CONCLUSIONS

Itisevidentfromthispresentsurveythatmostofthesourcesofdomesticwateraswellasopenandgroundwatersourcesincertaincongested areasofKolkataarecontaminatedwithbacterialpathogenscapableofcausingentericdiseasesanddonotmeettheWHOguidelinesfordrinkingwater quality. The physical and chemical parameters are more-or-less within the acceptablelimitsofWHOguidelineswithfewexceptionsincertainareas.Allthesefactorsmightpose forpossible human health hazards particularly to the residents of those zones and they are at riskof acquiring water-borne diseases as well as contaminated-water related diseases. The resultsof this study also suggest that tap water may be safer, but additional sampling is needed incomparisontoopenwatersourceslikepondsfordrinkingpurpose.Moreoverthebacteriological contaminations are also possible from leakage of pipelines and also the placeof storage and collection of potable water. Basic sewage disposable pipelines improvementmay be worthwhile at the momentforpreventing the faecal bacterialcontaminationsindrinking water. Basic treatment of the water at the community or household level by chemicaldisinfectionusingchlorine,filtrationusingsimplehousehold filters,andboilingshouldalsobepromoted. Thus few simple interventions may mitigate the health hazards associated withpotable water and ensures access to safe drinking water which in turn would result in 200million/year fewer diarrheal episodes and 2.1 million/year fewer deaths caused by diarrhea(Esreyetal.,1991).

2 METHODOLOGY



భారతీయ ప్రామాణికాల సంస్థ(BIS)

IS 10500-2012

మంచినీటికి ఉండవలసిన లక్షణాలు

(భౌతిక మరియు రసాయనిక పరీక్షలు)

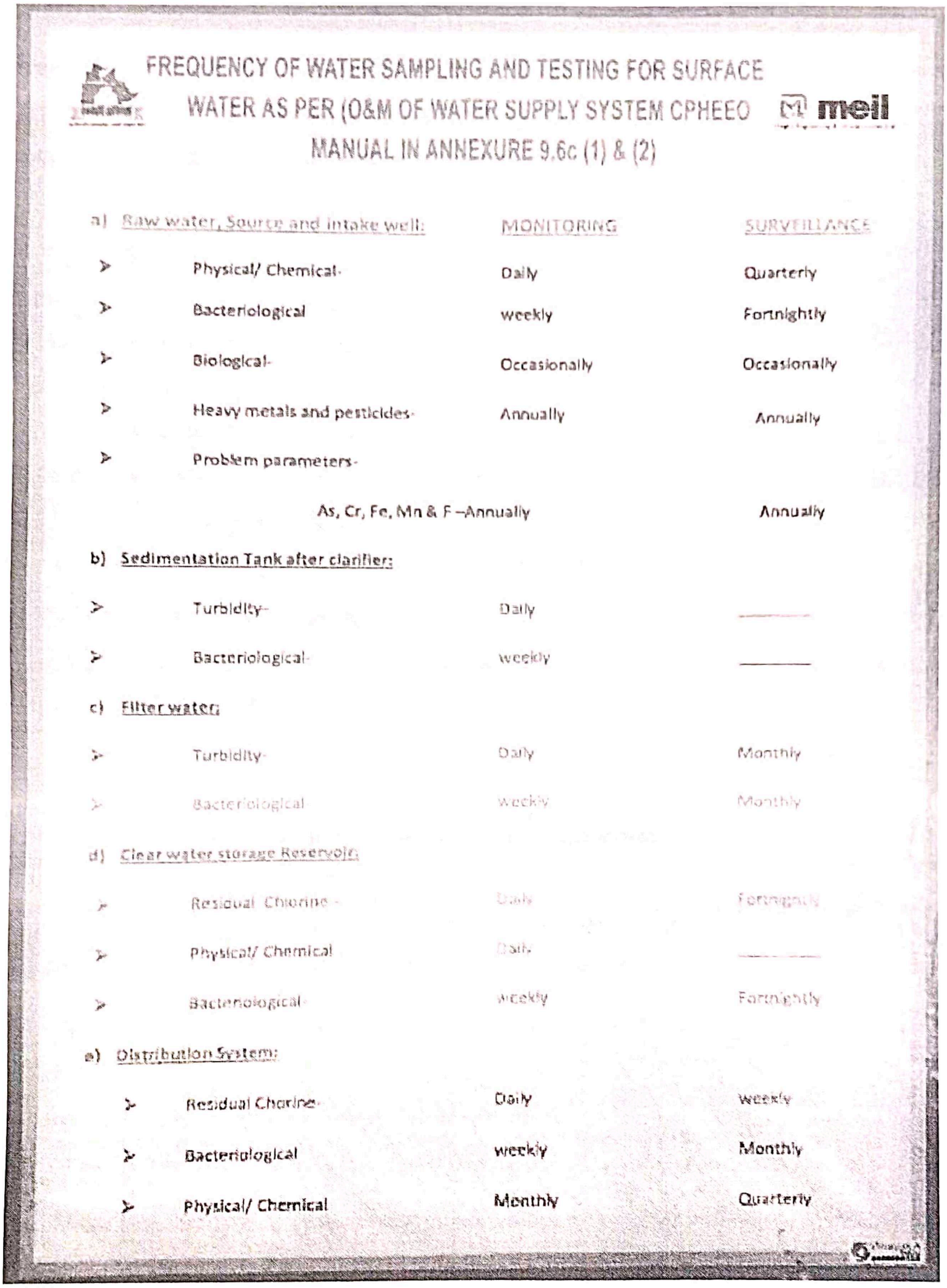
క్ర.సం	లక్షణము Characteristic	[illegible]	[illegible]	[illegible]
1.	రంగు	ఆమోదయోగ్యముగా ఉండాలి	ఆమోదయోగ్యముగా ఉండాలి	[illegible]
2.	వాసన	-	-	-
3.	రుచి	-	-	-
4.	మడ్డిదనము (NTUS)	1	5	-
5.	పిహెచ్ (pH)	6.5-8.5	సడలింపు లేదు	[illegible]
6.	[illegible]	500	2000	[illegible]
7.	[illegible] (as $CaCO_3$)	200	600	[illegible]
8.	[illegible] (as $CaCO_3$)	300	600	[illegible]
9.	కాల్షియం [illegible]	75	200	- -
10.	క్లోరైడ్స్ [illegible]	250	1000	[illegible]
11.	[illegible]	0.2	1.0	[illegible]
12.	[illegible] (as SO_4)	200	400	[illegible]
13.	నైట్రేట్ [illegible]	45	సడలింపు లేదు	[illegible]
14.	ఫ్లోరైడ్ [illegible] (as F)	1.0	1.5	[illegible]
15.	ఇనుము (as Fe) [illegible]	0.3	1.0	[illegible]
16.	మెగ్నీషియం [illegible]	30	100	[illegible]
17.	అల్యూమినియం (Al) (as Al) [illegible]	0.03	0.20	[illegible]

మంచినీటిలో సూక్ష్మజీవ సంబంధితాల ప్రామాణికాలు

క్ర.సం	[illegible]	[illegible]
(I)	[illegible]	100 [illegible]
(II)	[illegible]	- -
(III)	[illegible]	- -

మిషన్ భగీరథ నీటి పరీక్షా ప్రయోగశాల

Figure8 Waterqualitytests



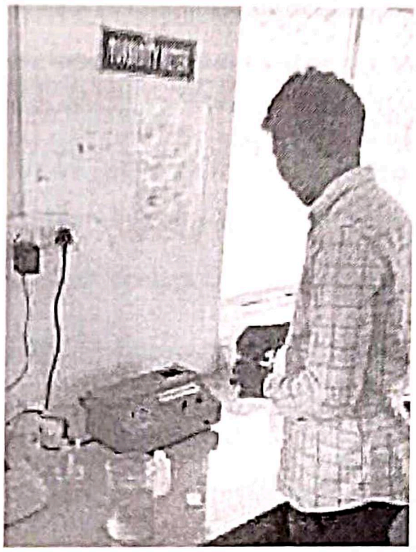
FREQUENCY OF WATER SAMPLING AND TESTING FOR SURFACE WATER AS PER (O&M OF WATER SUPPLY SYSTEM CPHEEO MANUAL IN ANNEXURE 9.6c (1) & (2)

		MONITORING	SURVEILLANCE
a)	Raw water, Source and intake well:		
➢	Physical/ Chemical-	Daily	Quarterly
➢	Bacteriological	weekly	Fortnightly
➢	Biological-	Occasionally	Occasionally
➢	Heavy metals and pesticides-	Annually	Annually
➢	Problem parameters-		
	As, Cr, Fe, Mn & F –Annually		Annually
b)	Sedimentation Tank after clarifier:		
➢	Turbidity-	Daily	________
➢	Bacteriological-	weekly	________
c)	Filter water:		
➢	Turbidity-	Daily	Monthly
➢	Bacteriological-	weekly	Monthly
d)	Clear water storage Reservoir:		
➢	Residual Chlorine -	Daily	Fortnightly
➢	Physical/ Chemical	Daily	________
➢	Bacteriological-	weekly	Fortnightly
e)	Distribution System:		
➢	Residual Chorine-	Daily	weekly
➢	Bacteriological	weekly	Monthly
➢	Physical/ Chemical	Monthly	Quarterly

Figure 9 Water Quality Tests

Testconductedforeveryfewhours

Turbidity:



Turbidityisameasureofhowcloudywateris.Sometimesalsotermedwaterclarity,turbidityisoftenusedasameasureofthesanitaryqualityofwaterandoftenindicatesthatfiltersarenotworkingproperly.

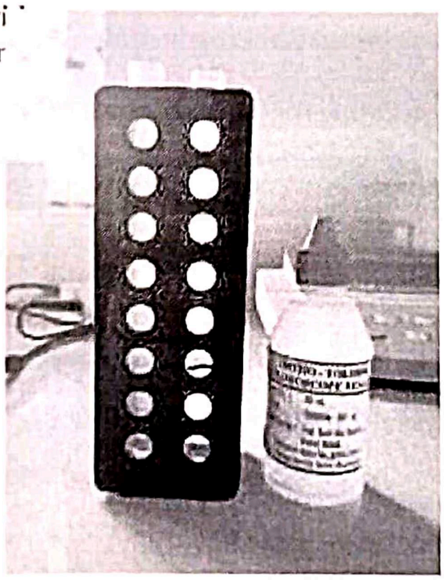
Turbidity is a critical parameter for drinking water; it isoneofthemostimportantandregulartestsdonebydrinkingwatercompanies.Turbiditymonitoringisusedtomeasure water processing efficiency in drinking water.Turbidity changes in drinking water can be caused by amultitudeofthings;itcanindicatethatthefiltersarenot workingcorrectly,thatthereisaproblemwiththewater, ineffectivedisinfectionorpoorcoagulationand flocculation.

Figure10:Turbiditytestingapparatus

The WHO set a limit that the turbidity of drinking water should not be more than 5 NTU, andshould ideally be below 1 NTU. Most UK water companies aim to reach a target of less than1NTU at the drinking water treatment works. Turbidity testing is widely performed by watercompanies,readourcasestudyontheSuttonandEastSurreywatercompanyto findoutsomeoftheturbiditychallengeswater companies faceandhowtheyovercamethemusingPalintestequipment.

ResidualChlori

Testingforchloriner



The most common test is the dpd (diethyl paraphenylenediamine) indicator test, using a comparator. This test isthe quickest and simplestmethod for testing chlorineresidual. With this test, a tablet reagent is added to asampleofwater,colouringitred.

Chlorineisanaturallyoccurringelementfoundingaseous form at room temperature. The highly reactivenatureofchlorinemeansitisusuallyboundwithothe r elements,suchassodiumchloride(salt).Astrong oxidizingagent,Chlorinedeactivatesmicroorganismsbybreakingthroughthecellmembrane

Figure11 Ortho-TolidineChoroscopereagent

Chlorinewasfirstaddedtodrinkingwatersystemsinthe19thcenturytocombatdiseasessuchas cholera. Since then, chlorine has been widely adopted as a disinfectant across multipleapplications,includinginswimmingpoolsandforwashingfoodproduce.Aswithalldisinfectants, monitoring of residuals and dosing is important to ensure that levels are not toohigh or low. Chlorine levels are routinely monitored to ensure that water is free of harmfulbacteria. However, because it is very sensitive to pH and temperature, both those parametersmustbe testedandcarefullycontrolledtoachieve optimumperformance.

Most drinking water is treated with chlorine to prevent harmful bacteria causing illness inhumans and animals. Whether added as free chlorine or a combined chlorine depends verymuchonhowquicklythewateristobeconsumed andthepotentialfordisinfectionbyproductformation.

PH

PH is a measure of how acidic/basic water is. The rangegoes from 0 to 14, with 7 being neutral. pHs of less than 7indicate acidity, whereas a pH of greater than 7 indicates abase. The pH of water is a very important measurementconcerningwater quality.

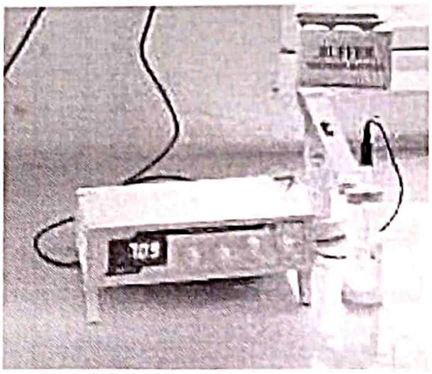


Figure12.PHtestingapparatus

Oneofthemostimportantindicatorsforwaterqualityisitsplevel.ThepHscalerunsfrom0to14 andmeasuresthe acidorbasequalityofwater.ApHof7isneutral,whilea readingbelow7isacidic,andoneabove7isalkalineorbasic.WaterqualitydependsonproperpHlevels .Inacidicwater,forexample,toxicheavymetalsdissolveeasilyandaremoreharmfultolivingthings.ThepHlevelalsoaffectstheavailabilityofessentialplantnutrients,withmanynutrients beingless availableatapHabove7

PHofDrinkingWater

ThereisnolegallyenforceablestandardfordrinkingwaterpHlevelsbecausepHisconsideredanaestheticwaterquality.However,theU.S.EnvironmentalProtectionAgency(EPA)recommends a pH between 6.5 and 8.5 for drinking water. Since metals dissolve readily inacidic water, dissolved metals may be present in drinking water with a low pH level. Metalssuchasiron,manganese,copper,andleadcanleachinto drinkingwater frompipesorthelocalaquifer.

Inacidicwater,ironcausesametallictasteaswellasreddishstainsonclothingandplumbing,whileoth ermetalssuchasleadaretoxic. Alkalineor"hard"watercontainsexcesscalciumandotherminerals tha tcausethefamiliarscalydepositsoncookwareandabittertasteincoffee

TotalDissolvedSolids

TDS is a measure of the dissolved combined content of all inorganic and organic substancespresent in a liquid in molecular, ionized, or micro-granular (colloidal sol) suspended form.TDSconcentrationsareoftenreportedinpartspermillion(ppm).Water TDSconcentrationscanbedeterminedusinga digitalmeter.

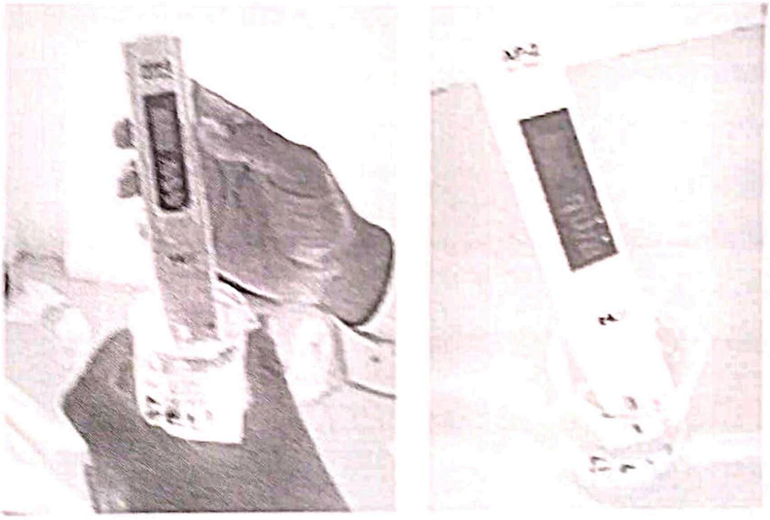


Figure 3: TDS testing apparatus

Bottled mineral water usually contains higher TDS levels than tap water. Generally, theoperational definition is that the solids must be small enough to survive filtration through afilter with 2-micrometer (nominal size, or smaller) pores. Total dissolved solids are normallydiscussed only for freshwater systems, as salinity includes some of the ions constituting thedefinition of TDS. The principal application of TDS is in the study of water quality forstreams, rivers, and lakes. Although TDS is not generally considered a primary pollutant (e.g.it is not deemed to be associated with health effects), it is used as an indication of aestheticcharacteristics of drinking water and as an aggregate indicator of the presence of a broadarrayofchemicalcontaminants.

Primary sources for TDS in receiving waters are agricultural runoff and residential (urban)runoff, clay-rich mountain waters, leaching of soil contamination, and point source waterpollution discharge from industrial or sewage treatment plants. The most common chemicalconstituents are calcium, phosphates, nitrates, sodium, potassium, and chloride, which arefoundinnutrient runoff,generalstormwaterrunoffandrunofffromsnowyclimateswhereroad de-icingsaltsareapplied.Thechemicalsmaybecations,anions,molecules,oragglomerationsontheorderofonethousandorfewer molecules,solongasasolublemicro-granuleisformed.More exotic and harmful elements of TDS are pesticides arising from surface runoff. Certainnaturally occurring total dissolved solids arise from the weathering and dissolution of rocksandsoils.TheUnitedStateshasestablishedasecondarywaterqualitystandardof500 mg/Ltoprovide for palatability of drinking water. Total dissolved solids are differentiated from totalsuspended solids (TSS), in that the latter cannot pass through a sieve of 2 micrometres and yetare indefinitely suspended in solution. The term settleable solids refers to material of any sizethat will not remain suspended or dissolved in a holding tank not subject to motion, andexcludes both TDS and TSS.[2] Settleable solids may include larger particulate matter orinsolublemolecules. Total dissolved solids include both volatileandnon-volatile solids.Volatile solids are ones that can easily go from a solid to a liquid state. Non-volatile solidsmust be heated to a high temperature, typically 550 °C, in order to achieve this state change.Examples ofnon-volatilesubstancesincludesaltsandsugars.

Conductivity

Conductivity is measured with a probe and ameter.Voltageisappliedbetweentwoelectrodes in a probe immersed in the samplewater.Thedropinvoltagecausedbytheresistance of the water is used to calculate theconductivitypercentimetre.

Conductivityisameasureof theability ofwatertopassanelectricalcurrent.Conductivity inwaterisaffectedbythe

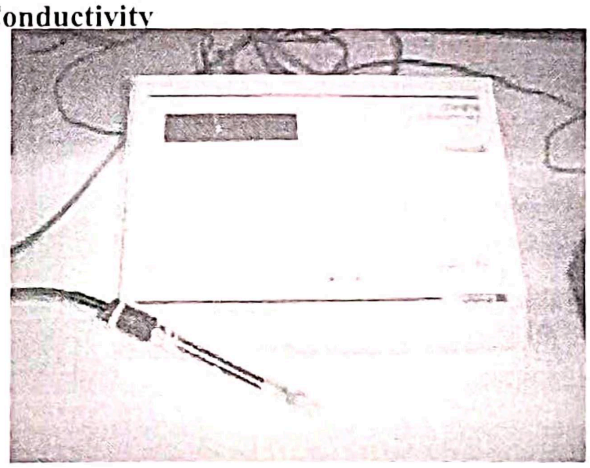


Figure14. Electricalconductivitymeter

presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate anions(ionsthatcarryanegativecharge)orsodium,magnesium,calcium,iron,andaluminumcations(ions that carry a positive charge). Organic compounds like oil, phenol, alcohol, and sugar donot conduct electrical current very well and therefore have a low conductivity when in water.Conductivityisalsoaffectedbytemperature:thewarmerthewater,thehigherthecondictivity. Forthisreason,conductivityisreportedasconductivityat25 degrees Celsius(25C).

Conductivity in streams and rivers is affected primarily by the geology of the area throughwhichthewaterflows.

into ionic components) when washed into the water. On the other hand, streams that runthrough areas with clay soils tend to have higher conductivity because of the presence ofmaterials that ionize when washed into the water. Ground water inflows can have the sameeffects dependingonthebedrocktheyflowthrough.

Discharges to streams can change the conductivity depending on their makeup. A failingsewage system would raise the conductivity because of the presence of chloride, phosphate,andnitrate;anoilspillwouldlowertheconductivity.

Thebasicunitofmeasurementofconductivityisthemho orsiemens.Conductivityismeasuredin micromhos per centimetre (µmhos/cm) or micro siemens per centimetre (µs/cm). Distilledwater has a conductivity in the range of 0.5 to 3 µmhos/cm. The conductivity of rivers in theUnited States generally ranges from 50 to 1500 µmhos/cm. Studies of inland fresh watersindicate that streams supporting good mixed fisheries have a range between 150 and 500µhos/cm.Conductivityoutsidethisrangecouldindicatethatthewaterisnotsuitableforcertainspeciesoffishormacroinvertebrates.Industrialwaterscanrangeashighas10,000µmhos/cm.

Hardness

Originally, the hardness of water was understood to be a measure of the capacity of water forprecipitating soap. Soap is precipitated chiefly by the calcium and magnesium ions commonlypresent in water, but may also be precipitated by ions of other polyvalent metals, such asaluminium, iron, manganese, strontium and zinc, and by hydrogen ions. Because, all but thefirst two are usually present in insignificant concentrations in natural waters, hardness isdefinedasacharacteristicofwater,whichrepresentsthetotalconcentrationofjustthecalciumand the magnesium ions expressed as calcium carbonate. However, if present in significantamounts,otherhardness producingmetallicionsshouldbeincluded.

When the hardness is numerically greater than the sum of the carbonate alkalinity and thebicarbonate alkalinity, the amount of hardness, which is equivalent to the total alkalinity, iscalled carbonate hardness; the amount of hardness in excess of this is called non-carbonatehardness. When the hardness is numerically equal to or less than the sum of carbonate andbicarbonate alkalinity all of the hardness is carbonate hardness and there is no noncarbonatehardness. The hardness may range from zero to hundreds of milligrams per litre in terms ofcalcium carbonate,depending on the source and treatmenttowhich the water has beensubjected.

Ethylenediaminetetra-aceticacidanditssodiumsaltsaceticacidanditssodiumsalts((EDTAEDTA)) form a chelated soluble complex form a chelated soluble complex whenaddedtoasolutionofcertainmetalcationswhenaddedtoasolutionofcertainmetalcations..If a small amount of a dye such asIf a small amount of a dye such as Eriochrome black T isadded to an aqueous solution containing calcium and magnesium ions stereochromes black Tis added to an aqueous solution containing calcium and magnesium ions at a pH of 10a pH of10 ± ± 0 0. .1 1, , the solution will become wine red the solution will become wine red. . IfEDTAisthenaddedasatitrantIfEDTAisthenaddedasatitrant,,thecalciumandmagnesiumwill be complexed calcium and magnesium will be complexed. . After sufficient EDTA hasbeen added to complex After sufficient EDTA has been added to complex all the magnesiumand calcium all the magnesium and calcium, , the solution will turn from wine red to blue thesolution will turn from wine red to blue. . This is the end point This is the end point of thetitrationofthetitration.

Jartest

Jar testing is a pilot-scale test of the treatment chemicals used in a particular water plant.Itsimulates the coagulation/flocculation process in a water treatment plant and helps operatorsdetermine if they are using the right amount of treatment chemicals, and, thus, improves theplant's performance.

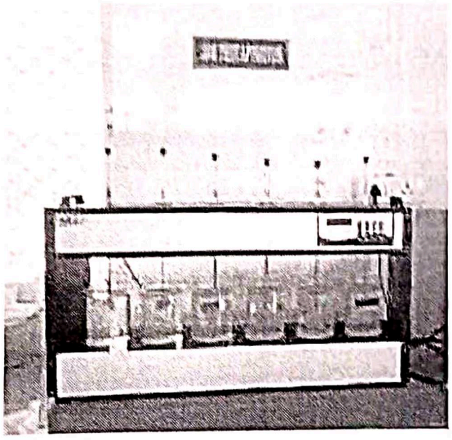


Figure15:Jartestapparatus

Dailyoncetitrations

Alkalinity

Alkalinitytestofwate r

Alkalineionisedwatercommonlyknownas Alkalinewaterhas highpHvalue. Notably,pHisa measure of the acid-base balance of water. Significantly, Alkalinity is one of the mostimportantthingsmeasuredinthechemistryofwater.

Usually,thepHofnaturalwaterrangesbetween6.5and 8.5,and itiscontrolledbythecarbondioxide-bicarbonate-carbonate equilibrium system. Alkalinity is present in water as dissolvedmineralslikecalciumandmagnesium.

The alkali metals are found in earth's crust and it is everywhere in nature. Alkalinity is theabilityofaliquidorsubstancetoresistachangeinpH,orthecapacityofwatertobufferagainstanacid .

Alkalinity indicates how much acid a solution can absorb without changing the pH. It is thebuffering capacity of a solution (water). Therefore, solutions with low alkalinity have a lowerbuffering capacity,and changepHratherquicklywhensomethingacidicisadded.

Onthecontrary,highalkalinityofwatersampleshaveahigherbufferingcapacityandarelessaffected when something acidic is added. It becomes necessary to add a lot more acid in ordertoobtainthesame pHchangeasinalowalkalinityofwatersample.

Alkalinityofwaterdiffersaccordingtothegeographicallocation.Thesoilandmineralsoftheparticular geographical location influences the amount of alkalinity in natural water sources.Primarily,theareaswherelimestonearepresentpredominantlyhavehigheralkalinityinwater.

Alkalinity Measurement Alkalinity is essential in several industries for water treatment. It ishighlyessentialtoensurea properalkalinitytestfroma trustedwatertestinglaboratory.

Theaccuratemonitoring ofalkalinitywillsavematerials,moneyandtimeofusers.

When measuring alkalinity of water, the results are displayed as ppm of calcium carbonate($CaCO_3$). Hydroxide (OH^-) ions, bicarbonate (HCO_3^-) ions, and carbonate (CO_3^{2-}) ions allcontributetowateralkalinity.

Whetheritisdrinkingwaterorwastewatertreatmentprocessesalkalinityisaparameterthatisclosely monitored. Optimal alkalinity can streamline treatment, and cut down on the time additional materials needed, stalled treatment, end product imperfections, and environmentalimplications.

Howtodeterminealkalinityinwater

1. Takea20mlsamplesolutioninaconicalflaskandadd2-3dropsofphenolpathaleinindicator.
2. TitratethisagainstHClsolutionuntilthesolutionbecomescolourless,notethereadings.
3. Add2-3dropsofmethylorangeindicatorandtitrateitagain.
4. Stopwhenyou seeredcolour and notedownthereading.

Totalalkalinitymeasuresthelevelofalkalineinwater,itisthemeasurementoftheconcentrationofalla lkalinesubstancesthatdissolvesinwater.

Total alkalinity is measured by measuring the amount of acid (e.g., sulfuric acid) needed tobring thesample topHof4.2.AtthispH allthealkaline compoundsinthesample are"usedup."Theresultisreportedasmilligramsperliterofcalciumcarbonate(mg/LCaCO3).

It can be appositely tested in a laboratory. For instance, in swimming pools water bicarbonatealkalinityshouldbe inbetween80ppmand120ppm.IfthetotalalkalinityiswithinthisrangethenitwillpreventrapidpHch anges and willstabilizethepHlevelinthewater.

If the total alkalinity is lower than required level the pool water could turn green and it willcauseirritationineyesofpeopleandrigidstains onwalls ofthepool.

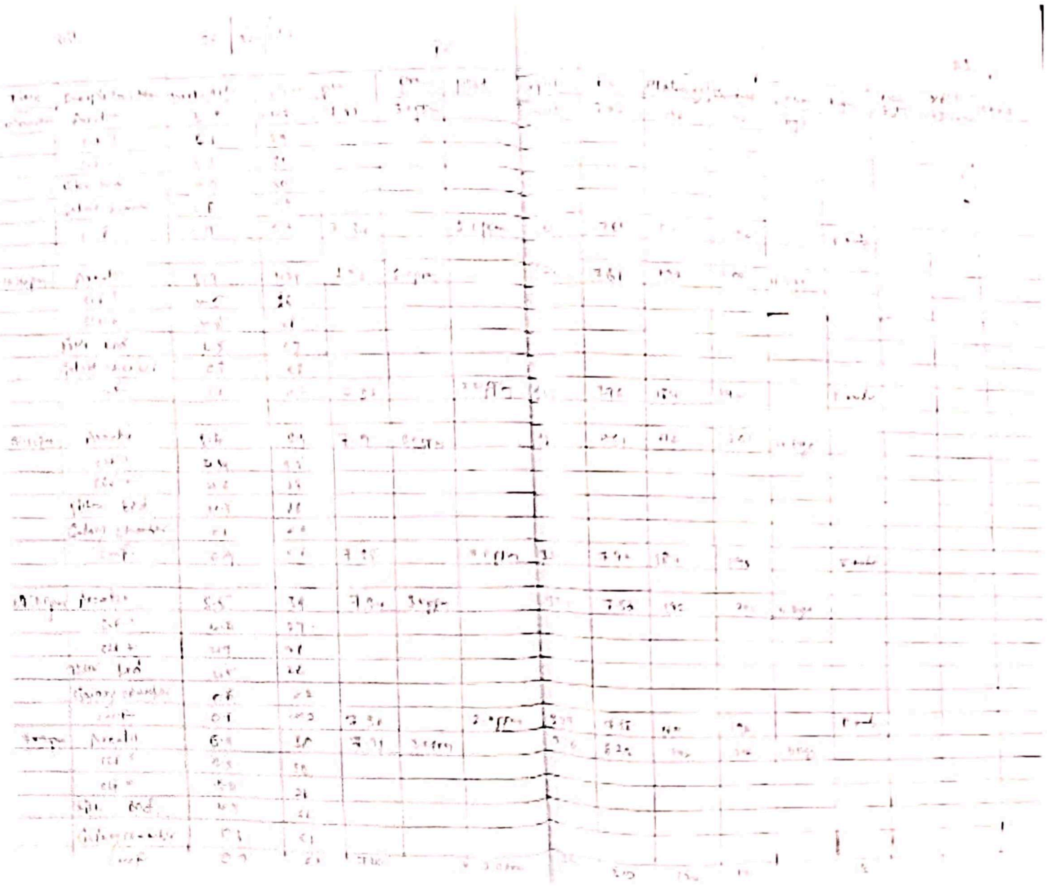
TypesofAlkalinity

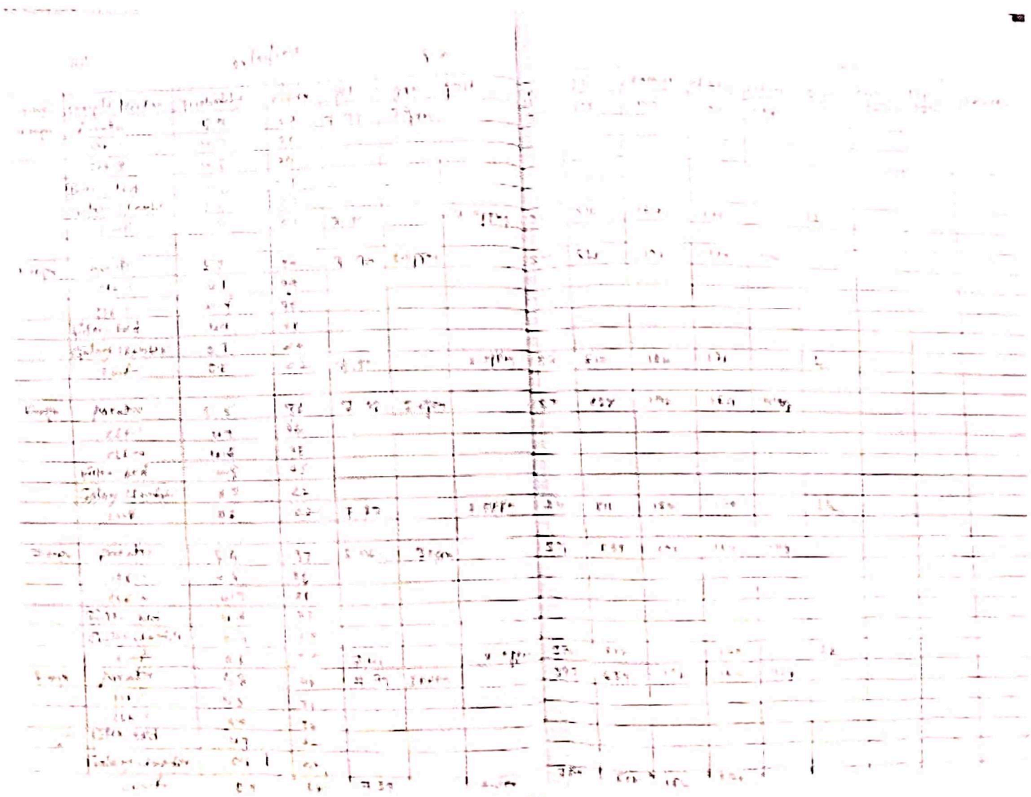
TwotypesofAlkalinitypresentinwater,

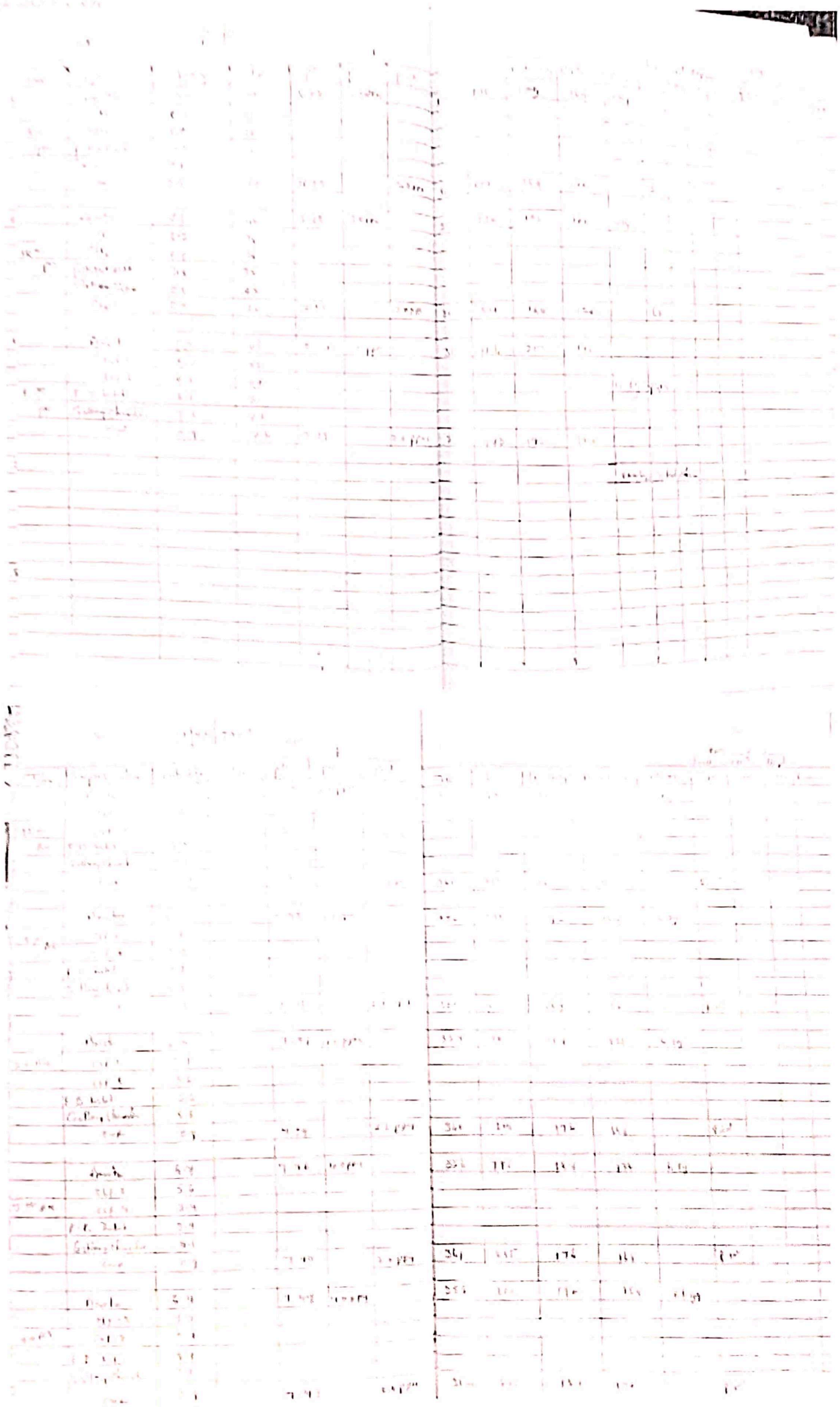
1. P-AlkalinityalsocalledPhenolphthaleinAlkalinitybecausePhenolphthaleinindicatorusedforanalys is

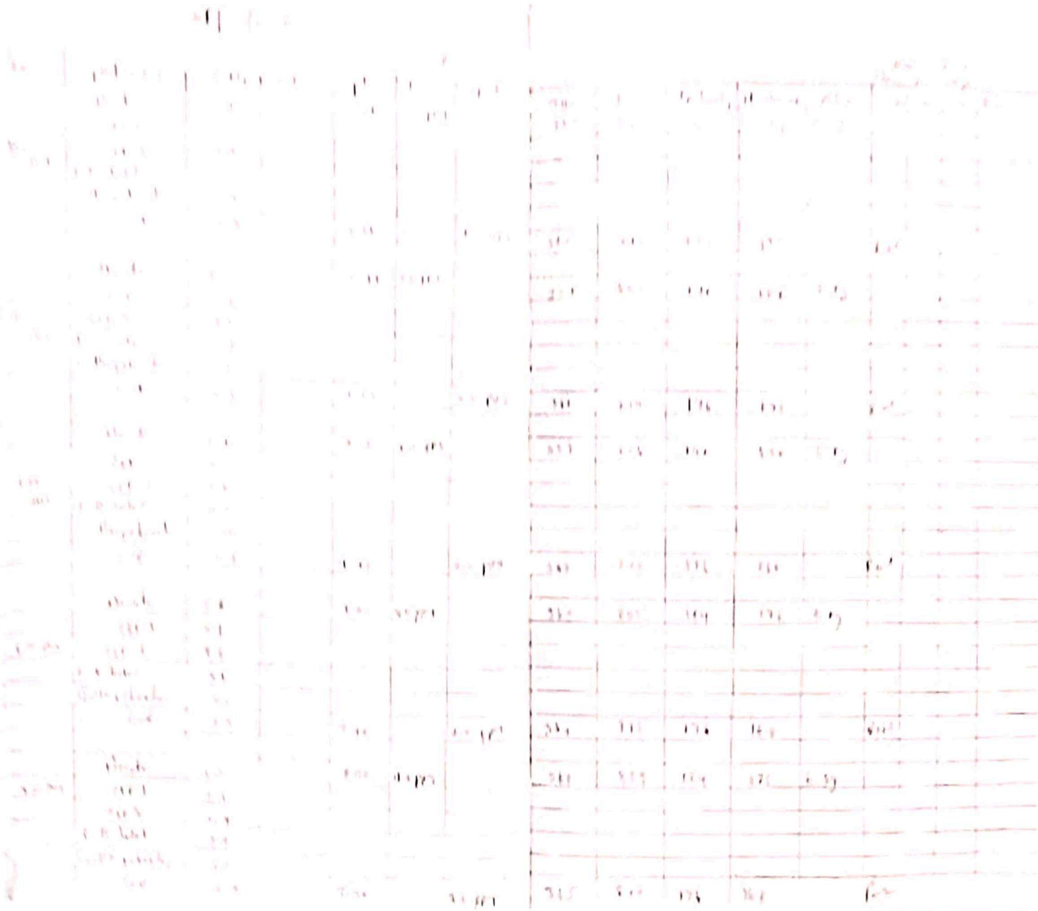
2. M-AlkalinityalsocalledMethylorangeAlkalinitybecauseMethylorangeindicatorusedforanalys

Thesearetheresultsofthehourlyanddailytestperformedinthelaboratory









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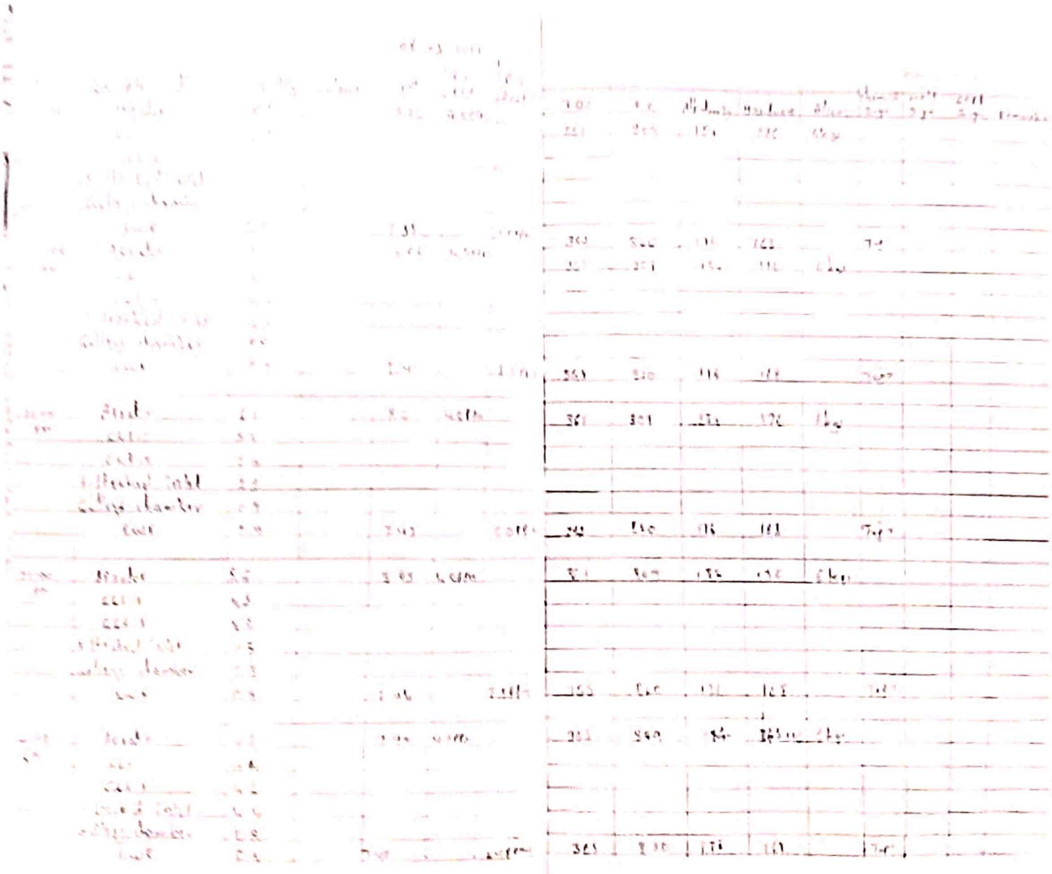


DailytesttocheckthebacterialpresenceH2STest

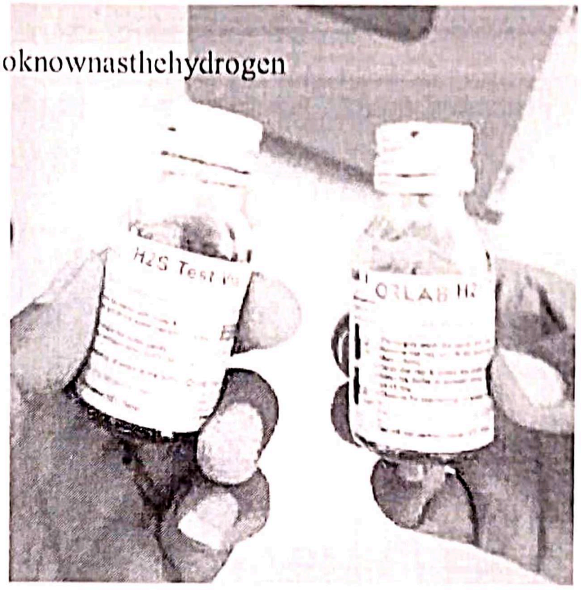


Figure16: H2Swatertestingmethodforbacterialidentification

TheH2Stest,alsoknownasthehydrogen sulphidetest,isasimpleandwidelyusedmethodtodetectthepresenceofsulphides,suchas hydrogen sulphide (H2S), in water. Here is adetailedprocedureforperforming theH2Stest:

If thewatersampleturnsyellow,brown,orblack,itindicatesthepresenceofhydrogensulphide.Theintensityofthe colourchangecorrelates with the concentration of H2S in thewater sample. The colour chart provided withthetestkitcanbeusedtoestimatetheconcentrationofH2Sinthe watersample.

MacConkeybroth

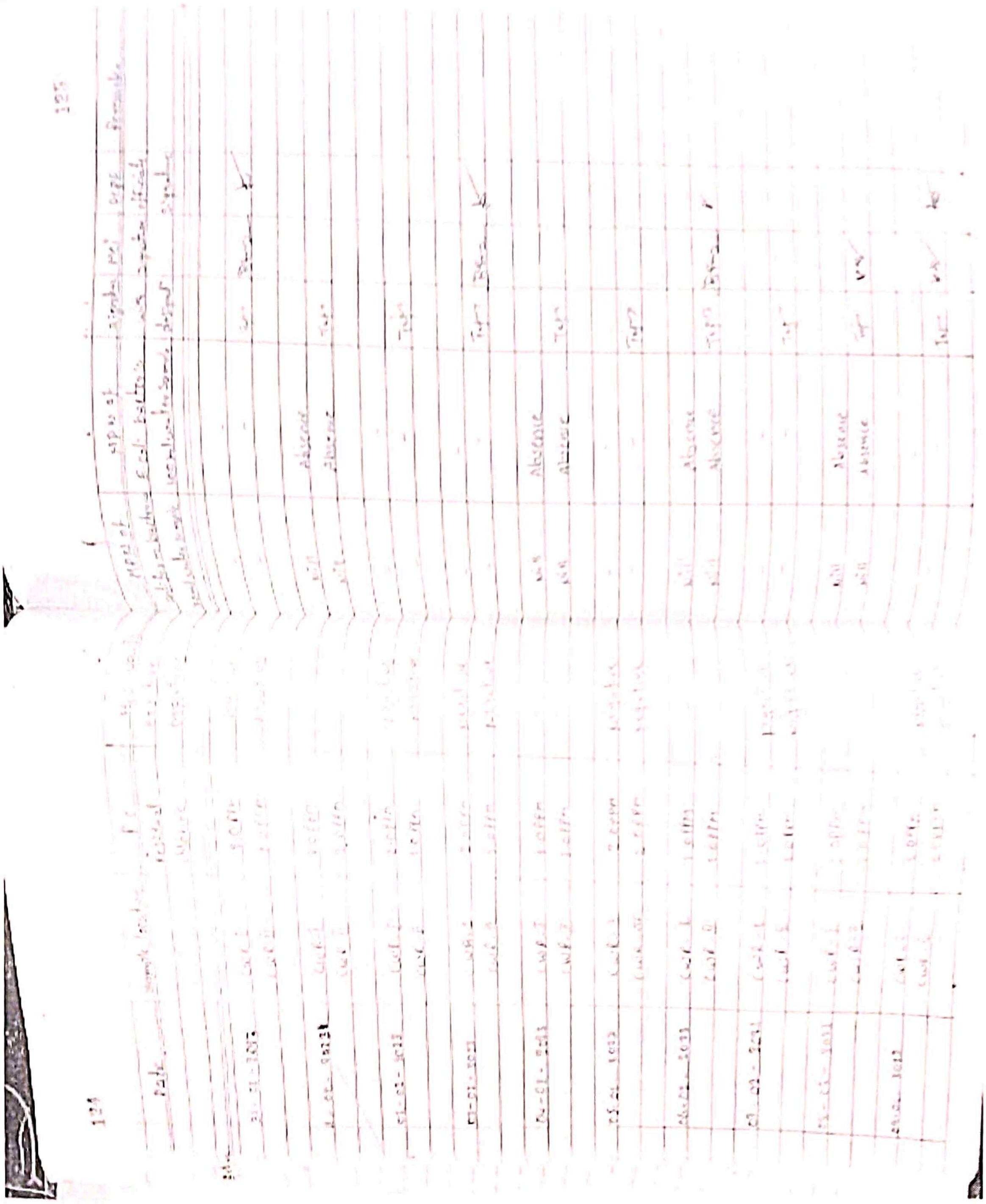
Figure 17: MacConkey broth doublestandardtubes

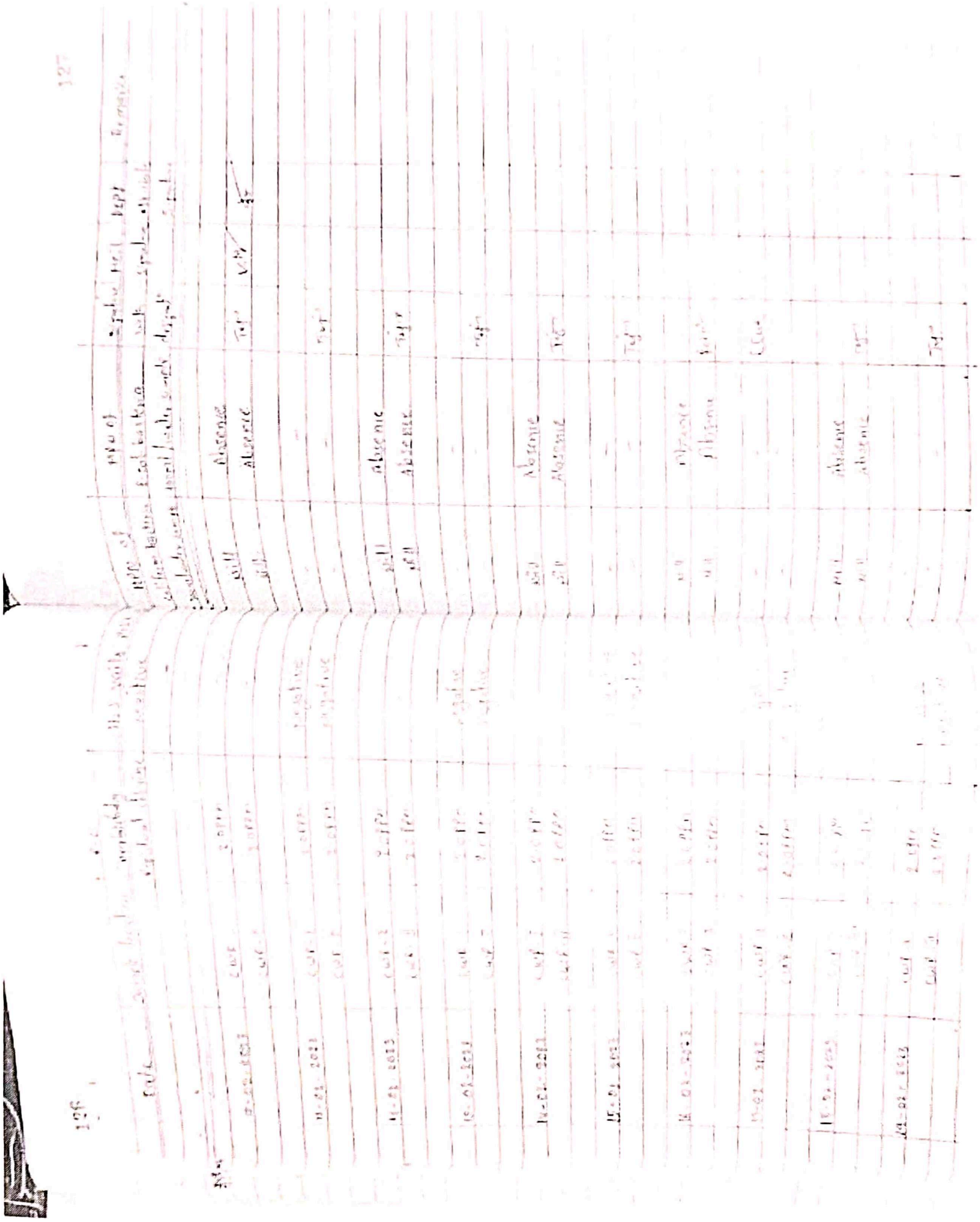
TheMacConkeybrothtestisacommonlyusedmethodtodetectthe presence of coliform bacteria and E. coli in water samples.It involves inoculating a sample of the water being tested intoMacConkey broth, which contains lactose and bile salts, andincubatingitfor24-48hoursat35-37°C.

If coliform bacteria are present in the water sample, they willferment the lactose in the broth and produce acid, causing thebroth toturnyellow.E.coli will alsofermentlactoseandproduceacid,butitwillalsoproducegas,whichcanbedetectedbyobservinggas bubblesorbyusingaDurhamtube.

IfthebrothremainspinkorpurpleafterincubationitindicatestheabsenceofcoliformbacteriaandE.coli.

Overall,theMacConkeybrothtest isausefultoolformonitoringwaterqualityandidentifyingpotentialsourcesofcontamination.Itisoftenusedinconjunctionwithothertestsandmethodstoprovidea comprehensiveanalysisofwatersamples.





Chemical usedinwatertreatmentprocess

1. Aluminium sulphate, also known as alum, is commonlyaddedtothewatertreatmentprocessasacoagulant.Coagulationistheprocessofbringingtogethersmallparticlesinwatertoformlarger,moreeasilyremovedparticles.

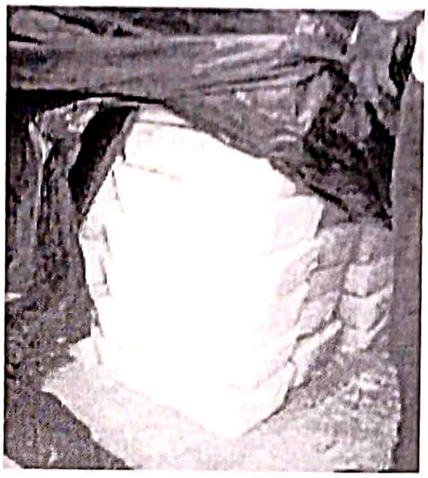


Figure18:Aluminumsulphatebricks

When aluminium sulphate is added to water, it reacts withthe water to form aluminium hydroxide, which then reactswith the small particles in the water to form larger, heavierparticlescalledflocs.Theseflocsarethenabletosettlemoreeasily to the bottom of the water treatment tank or float tothesurface,makingiteasiertoremovethemfromthewater.

Alum is particularly effective at removing suspended solids and turbidity (cloudiness) fromwater.Itcanalsohelptoremoveotherimpuritiessuchasbacteria,viruses,andorganicmatter.Additionally, alum can help to control the pH of the water and improve the effectiveness ofdisinfectantsusedinthewatertreatmentprocess.

Overall,theadditionofaluminiumsulphateisanimportant stepinthewatertreatmentprocessasithelpstoimprovethequality andsafety of thewaterby removingimpuritiesandcontaminants.

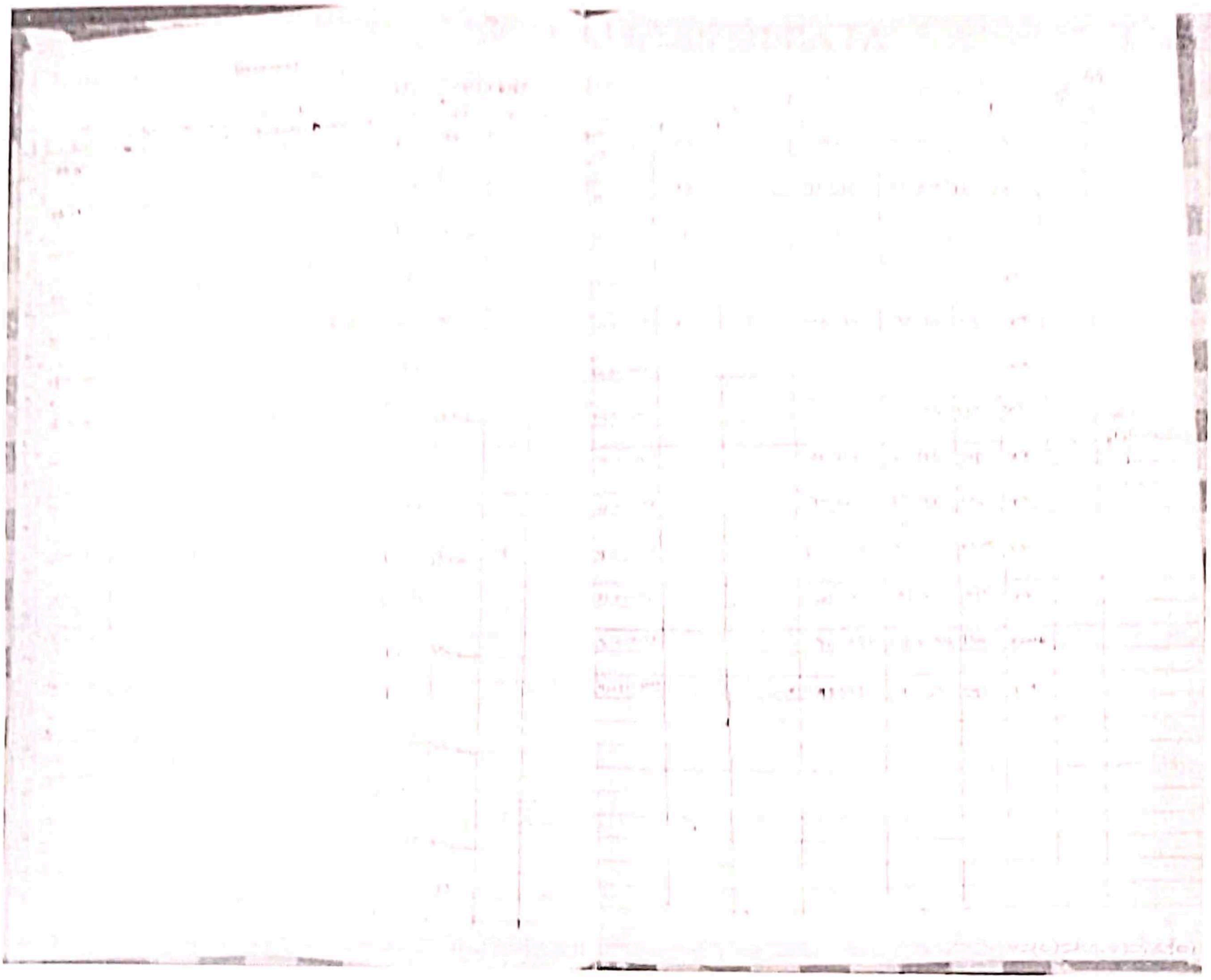
2. Chlorine: To preventcontamination with germs,water companies add a disinfectant—usually either chlorine or chloramine—that kills disease-causing germs such as Salmonella,Campylobacter,andnorovirus.

Itisaddedtothe water inthe formofgas.

Chlorineisaddedtowaterintwostepsthatisprechlorineandpostchlorine,

ThePre chlorine addedto r

aw water is 4ppm and the post chlorine added to clear water is 2ppm, at the time of watersupply the chlorine will get evaporated and the percentage of chlorine present in water is 0.2to0.5ppmwhichis ediblefor drinking



3 ANALYSISOFDATA

Water pollution can occur due to the discharge of untreated or partially treated wastewater,agricultural runoff, industrial waste, or other human activities. Bacterial pollutants that arecommonlyfoundinwaterbodiesinclude:

1. Escherichia coli (E. coli): E. coli is a common bacterium found in the intestines of humansand animals. The presence of E. coli in water indicates fecal contamination, which can lead tothespreadofwaterbornediseases.

2. Salmonella:Salmonellaisagroupofbacteriathat cancauseillnessessuchastyphoid fever,foodpoisoning,andgastroenteritis.Itiscommonly foundincontaminatedwatersources.

3. Vibrio cholerae: Vibrio cholerae is a bacterium that causes cholera, a serious diarrhealdisease that can lead to dehydration and death if left untreated. It is typically found in areaswithpoorsanitationandhygiene.

4. Shigella:Shigellaisagroupofbacteriathatcancausediarrhealdiseases,includingdysentery.Itis typicallytransmittedthroughfaecal-oralcontamination.

5. Legionella:Legionella isabacteriumthatcausesLegionnaires'disease,atypeofpneumonia.Itiscommonlyfoundinstagnant watersourcessuchascoolingtowersandhotwatersystems.

To prevent water pollution and the spread of bacterial pollutants, it is important to properlytreat anddisposeofwastewater,minimizeagriculturalandindustrialrunoff,andpracticegoodhygieneand sanitationmeasures.

4 FINDINGS

Thewatershould havecertainqualitieswhichmake it edible fordrinkingwithoutcausinganyharm/healthrelatedissuestoitsconsumers theyare:

TURBIDITY:Thenormalrangeofturbidityofwatershouldbeinbetween1-5 NTU.

RESIDUALCHLORIDE:Thenormalrangeofthechlorinepresentinwatershouldbeinbetween0.2to 0.5.

PH: ThenormalPHrange ofthewatershouldbeinbetween6.5to8.5.

TDS:ThenormalTDS(TOTALDISSOLVEDSOLUTES)rangeofwatershouldbeinbetween210t o800mg/ltr.

ALKINITY: The alkinity of water should be in between 300 to 400

mg/ltr.HARDNESS: The hardness of water should be in between 300 to 600

mg/ltr.CONDUCTIVITY: The conductivity of water should be in between 300 to 600

mg/ltr.These are the qualitiesofwaterwhichmakethemedibleFordrinking.

5 DISCUSSION

Maintenance and Treatment of water in the water treatment plant is a difficult task .Weshouldtakegoodcareandfollowprotocolsduringitstreatmentintheplant.Whenthewaterisbrought fromtheriverto theplant,itisverymuchpolluted withphysicalwastelike soil,dustandetc.These riverwaterentersthe plantthroughthe Aeratorfromthere the rawwater sample is collected and tested for its TURBIDITY, RESIDUAL CHLORINE, PH,TDS, CONDUCTIVITY, HARDNESS, ALKINITY and also tests to identify the bacterialpresencelike H2STESTandMACCONKEYBROTHTEST.

By these tests they analyse the water completely and take required measures to make thewatersafefordrinking.After theanalysisofwatertheyuserequiredamountofchemicalslikeALUMINIUMSULPHATEwhich isused tomakethe waterclearfromphysicalpollutants/impurities and CHLORINE is used for the disinfection of water and make themfreefromcoliformbacterialwhichareharmfulifconsumed.

6 CONCLUSION

Bacterial analysis of water is an essential aspect of public health, as contaminated water cancause waterborne diseases like cholera, typhoid fever, and diarrhea. In India, several citieshavebeengrapplingwithwatercontaminationissues,includingHyderabad,Delhi,Mumbai,Kolkata,andChennai.

Hyderabad: According to a study conducted by the National Environmental EngineeringResearch Institute (NEERI), the water quality in Hyderabad is generally good, with fewinstances of contamination. However, the city's growing population and industrializationhave putpressure onthe watersupplyandincreasedthe risk ofcontamination.

Delhi:Delhi'swatersupplyisamixofsurfaceandgroundwatersources. However,thecity'sgroundwater is heavily contaminated due to industrial and domestic wastewater, making itunsuitable for drinking without treatment. According to a study by the Central PollutionControl Board (CPCB), nearly 80% of Delhi's groundwater is contaminated with coliformbacteria,whichindicatesfecalcontamination.

Mumbai: Mumbai's water supply comes from several sources, including the Tansa, Vaitarna,andModakSagar reservoirs. However,thecity'swatersupplyisalsoatriskofcontaminationdue to inadequate sewage treatment, industrial pollution, and encroachment on water bodies.Kolkata: Kolkata's water supply comes primarily from the Hooghly River, which is heavilypolluted with industrial waste and sewage. The city's water treatment facilities are alsooutdated, leadingtoconcerns aboutthesafetyofthe watersupply.

Chennai: Chennai has been facing severe water scarcity issues in recent years due toinadequate rainfall and mismanagement of water resources. The city's groundwater is alsocontaminatedwithhighlevelsoffluorideandarsenic,making itunsuitable forconsumptionwithouttreatment.

In terms of the treatment of water, there are significant differences between these cities. Forexample, Hyderabad has invested in advanced water treatment technologies like reverseosmosis and ultrafiltration to ensure water quality. Delhi has recently implemented acomprehensive plan to improve the city's water supply, including the installation of newtreatment plants and the revival of water bodies. Mumbai has also initiated several measuresto improve water quality, including the construction of new sewage treatment plants and theimplementation of stricter industrial pollution control regulations. Kolkata has beenupgradingitswatertreatmentfacilitiestomeetthegrowingdemandforcleanwater.Chennai,ont he otherhand,hasbeenrelyingondesalinationplantstoprovide drinkingwaterduetothescarcityoffreshwaterresources.

Inconclusion,bacterialanalysisofwateriscrucialtoensurepublichealthinIndiancitieslikeHyderabad, Delhi, Mumbai, Kolkata, and Chennai. Although these cities have their uniquewater quality challenges, investment in advanced water treatment technologies and propermanagement of water resources can help improve water quality and reduce the risk ofwaterbornediseases.

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